**CLAIMS**

What is claimed is:

1. A method of applying overlaid perturbation vectors for gradient feedback transmit antenna array adaptation in a communication system, wherein the communication system includes a transmitter and a receiver, and wherein the transmitter includes a plurality of antennae, comprising the acts of:
   a) overlaying at least one weight vector perturbation vector;
   b) measuring multiple weight vector perturbation vectors during a measurement interval, wherein the measurement interval has a greater duration than a feedback interval;
   c) generating a feedback based on the measurements of act (b);
   d) determining a new weight vector perturbation vector based on the feedback generated in the act (c); and
   e) returning to the act (a).

2. The method of applying overlaid perturbation vectors as defined in Claim 1, wherein the act (c) comprises generating at least one feedback bit per feedback interval.

3. The method of applying overlaid perturbation vectors as defined in Claim 1, wherein the communication system comprises a DS-CDMA communication system.

4. The method of applying overlaid perturbation vectors as defined in Claim 1, wherein the measurement interval is approximately 2 times the feedback interval.

5. The method of applying overlaid perturbation vectors as defined in Claim 1, wherein an even weight vector, an odd weight vector and a data weight vector are represented by the following equations:

i) $$\mathbf{w}_{even}(i)=\frac{\mathbf{w}_{base}(i)+\beta\|\mathbf{w}_{base}(i)\|\cdot\sum_{k=i-I+1}^{i}\mathbf{v}(k)}{\left\|\mathbf{w}_{base}(i)+\beta\|\mathbf{w}_{base}(i)\|\cdot\sum_{k=i-I+1}^{i}\mathbf{v}(k)\right\|};$$

ii) $$\mathbf{w}_{odd}(i)=\frac{\mathbf{w}_{base}(i)-\beta\|\mathbf{w}_{base}(i)\|\cdot\sum_{k=i-I+1}^{i}\mathbf{v}(k)}{\left\|\mathbf{w}_{base}(i)-\beta\|\mathbf{w}_{base}(i)\|\cdot\sum_{k=i-I+1}^{i}\mathbf{v}(k)\right\|};\text{ and}$$

iii) $$\mathbf{w}(i)=\frac{\mathbf{w}_{even}(i)+\mathbf{w}_{odd}(i)}{2}.$$

6. The method according to Claim 5 wherein the perturbation vectors $\mathbf{v}(i)$ have a long term average or statistical autocorrelation given by the following equation:

$$\lim_{K\to\infty}\frac{1}{K}\sum_{k=i}^{i+K-1}\mathbf{v}(k)\mathbf{v}^{H}(k)=2\mathbf{I}.$$

7. The method according to claim 6 wherein the parameter $\beta$ defines an adaptation rate.

8. The method of applying overlaid perturbation vectors as defined in Claim 5, wherein the step (d) of Claim 1 comprises the following sub-steps:

   i) waiting for a new measurement interval and reception of the feedback;

   ii) if the feedback indicates that an even channel yields better results, then determining a base weight utilizing a first equation, else determining the base weight utilizing a second equation; and

   iii) determining new values of the even weight vector, the odd weight vector and the data weight vector.

9. The method of applying overlaid perturbation vectors as defined in Claim 8, wherein the first equation is represented by the following equation:

$$\mathbf{w}_{base}(i)=\frac{\sum_{k=i-I}^{i-1}\mathbf{w}_{even}(k)}{\left\|\sum_{k=i-I}^{i-1}\mathbf{w}_{even}(k)\right\|}.$$

10. The method of applying overlaid perturbation vectors as defined in Claim 8, wherein the second equation is represented by the following equation:

$$\mathbf{w}_{base}(i)=\frac{\sum_{k=i-I}^{i-1}\mathbf{w}_{odd}(k)}{\left\|\sum_{k=i-I}^{i-1}\mathbf{w}_{odd}(k)\right\|}.$$

11. The method of applying overlaid perturbation vectors as defined in Claim 1, wherein the method is capable of independently adjusting a first perturbation size that is applied at transmission during a measurement interval and a second perturbation size applied as an update to a tracked weight vector.

12. The method of applying overlaid perturbation vectors as defined in Claim 1, wherein the method is capable of representing lagged feedback through utilization of multiple indices.

13. The method of applying overlaid perturbation vectors as defined in Claim 12, wherein the method comprises a first index and a second index.

14. The method of applying overlaid perturbation vectors as defined in Claim 13, wherein the second index represents one of two states, wherein a first state represents "before feedback received" and a second state represents "after feedback received".

15. The method of applying overlaid perturbation vectors as defined in Claim 13, wherein the sub-act (d) of Claim 1 comprises the following sub-acts:

   i) determining a first index base weight, a first index even weight, a first index odd weight and a first index data weight from a first set of equations;

   ii) waiting for the second time index to increment, wherein incrementing the second time index indicates a second state; and

   iii) if the feedback indicates that an even channel yielded better results, then determining a second index base weight, a second index even weight, a second index odd weight and a second index data weight from a second set of equations, else determining the second index base weight, the second index even weight, the second index odd weight and the second index data weight from a third set of equations.

16. The method of applying overlaid perturbation vectors as defined in Claim 15, wherein the first set of equations is represented by the following equations:

$$\mathbf{w}_{base}(i,0)=\mathbf{w}_{base}(i-1,1);$$

$$\mathbf{v}(i)=\text{normalized test perturbation function};$$

$$\mathbf{w}_{even}(i,0)=\frac{\mathbf{w}_{base}(i,0)+\beta_1\|\mathbf{w}_{base}(i,0)\|\sum_{k=i-I+1}^{i}\mathbf{v}(k)}{\left\|\mathbf{w}_{base}(i,0)+\beta_1\|\mathbf{w}_{base}(i,0)\|\sum_{k=i-I+1}^{i}\mathbf{v}(k)\right\|};$$

$$\mathbf{w}_{odd}(i,0)=\frac{\mathbf{w}_{base}(i,0)-\beta_1\|\mathbf{w}_{base}(i,0)\|\sum_{k=i-I+1}^{i}\mathbf{v}(k)}{\left\|\mathbf{w}_{base}(i,0)-\beta_1\|\mathbf{w}_{base}(i,0)\|\sum_{k=i-I+1}^{i}\mathbf{v}(k)\right\|};\text{ and}$$

$$\mathbf{w}(i,0)=\frac{\mathbf{w}_{even}(i,0)+\mathbf{w}_{odd}(i,0)}{2}.$$

17. The method of applying overlaid perturbation vectors as defined in Claim 15, wherein the second set of equations is represented by the following equations:

$$\mathbf{w}_{base}(i,1)=\frac{\mathbf{w}_{base}(i,0)+\frac{\beta_2}{\beta_1}\left(\frac{1}{I}\sum_{k=i-I}^{i-1}(\alpha\mathbf{w}_{even}(k,0)+(1-\alpha)\mathbf{w}_{even}(k-1,1))-\mathbf{w}_{base}(i,0)\right)}{\left\|\mathbf{w}_{base}(i,0)+\frac{\beta_2}{\beta_1}\left(\frac{1}{I}\sum_{k=i-I}^{i-1}(\alpha\mathbf{w}_{even}(k,0)+(1-\alpha)\mathbf{w}_{even}(k-1,1))-\mathbf{w}_{base}(i,0)\right)\right\|};$$

$$\mathbf{w}_{even}(i,1)=\frac{\mathbf{w}_{base}(i,1)+\beta_1\|\mathbf{w}_{base}(i,1)\|\sum_{k=i-I+1}^{i}\mathbf{v}(k)}{\left\|\mathbf{w}_{base}(i,1)+\beta_1\|\mathbf{w}_{base}(i,1)\|\sum_{k=i-I+1}^{i}\mathbf{v}(k)\right\|};$$

$$\mathbf{w}_{odd}(i,1)=\frac{\mathbf{w}_{base}(i,1)-\beta_1\|\mathbf{w}_{base}(i,1)\|\sum_{k=i-I+1}^{i}\mathbf{v}(k)}{\left\|\mathbf{w}_{base}(i,1)-\beta_1\|\mathbf{w}_{base}(i,1)\|\sum_{k=i-I+1}^{i}\mathbf{v}(k)\right\|};\text{ and}$$

$$\mathbf{w}(i,1)=\frac{\mathbf{w}_{even}(i,1)+\mathbf{w}_{odd}(i,1)}{2}.$$

18. The method of applying overlaid perturbation vectors as defined in Claim 15, wherein the third set of equations is represented by the following equations:

$$\mathbf{w}_{base}(i,1)=\frac{\mathbf{w}_{base}(i,0)+\frac{\beta_2}{\beta_1}\left(\frac{1}{I}\sum_{k=i-I}^{i-1}\left(\alpha\mathbf{w}_{odd}(k,0)+(1-\alpha)\mathbf{w}_{odd}(k-1,1)\right)-\mathbf{w}_{base}(i,0)\right)}{\left\|\mathbf{w}_{base}(i,0)+\frac{\beta_2}{\beta_1}\left(\frac{1}{I}\sum_{k=i-I}^{i-1}\left(\alpha\mathbf{w}_{odd}(k,0)+(1-\alpha)\mathbf{w}_{odd}(k-1,1)\right)-\mathbf{w}_{base}(i,0)\right)\right\|};$$

$$\mathbf{w}_{even}(i,1)=\frac{\mathbf{w}_{base}(i,1)+\beta_1\|\mathbf{w}_{base}(i,1)\|\sum_{k=i-I+1}^{i}\mathbf{v}(k)}{\left\|\mathbf{w}_{base}(i,1)+\beta_1\|\mathbf{w}_{base}(i,1)\|\sum_{k=i-I+1}^{i}\mathbf{v}(k)\right\|};$$

$$\mathbf{w}_{odd}(i,1)=\frac{\mathbf{w}_{base}(i,1)-\beta_1\|\mathbf{w}_{base}(i,1)\|\sum_{k=i-I+1}^{i}\mathbf{v}(k)}{\left\|\mathbf{w}_{base}(i,1)-\beta_1\|\mathbf{w}_{base}(i,1)\|\sum_{k=i-I+1}^{i}\mathbf{v}(k)\right\|};\text{ and}$$

$$\mathbf{w}(i,1)=\frac{\mathbf{w}_{even}(i,1)+\mathbf{w}_{odd}(i,1)}{2}.$$

19. The method of applying overlaid perturbation vectors as defined in Claim 13, wherein the sub-act (d) of Claim 1 comprises the following sub-acts:

i) determining a set of transmission weights according to a first set of equations, wherein the set of transmission weights are applied prior to receipt of feedback as indicated by a second time index;

ii) waiting for receipt of feedback;

iii) if the feedback indicates that an even channel yielded better results, then updating the set of transmission weights according to a second set of equations;

iv) if the feedback indicates that an odd channel yielded better results, then updating the set of transmission weights according to a third set of equations; and

v) applying the updated set of transmission weights after receipt of feedback as indicated by the second time index.

20. The method of applying overlaid perturbation vectors as defined in Claim 1, wherein the feedback comprises one bit.

21. The method of applying overlaid perturbation vectors as defined in Claim 1, wherein the feedback comprises multiple bits.

22. The method of applying overlaid perturbation vectors as defined in Claim 21, wherein the feedback comprises two bits.

23. The method of applying overlaid perturbation vectors as defined in Claim 21, wherein the feedback comprises three bits.

24. An apparatus applying overlaid perturbation vectors for gradient feedback transmit antenna array adaptation in a communication system, wherein the communication system includes a transmitter and a receiver, and wherein the transmitter includes a plurality of antennae, comprising:

a) means for overlaying at least one weight vector perturbation vector;

b) means, responsive to the overlaying means, for measuring multiple weight vector perturbation vectors during a measurement interval, wherein the measurement interval has a greater duration than a feedback interval;

c) means, responsive to the measuring means, for generating a feedback; and

d) means, responsive to the generating means, for determining a new weight vector perturbation vector based on the feedback generated by the measuring means.

25. The method for applying overlaid perturbation vectors as defined in Claim 24, wherein the generating means comprises means for generating a feedback by selecting a preferred direction for updating the at least one weight vector perturbation vector.

26. The method for applying overlaid perturbation vectors as defined in Claim 25, wherein the feedback is generated by indicating an update direction, wherein the update direction comprises a positive update direction.

27. The method for applying overlaid perturbation vectors as defined in Claim 25, wherein the feedback is generated by indicating an update direction, wherein the update direction comprises a negative update direction.

28. The method for applying overlaid perturbation vectors as defined in Claim 25, wherein the generating means comprises:

a) measurement means for measuring a measurement during a measurement interval, wherein the measurement interval has a longer duration that a feedback interval, and wherein the measurement interval comprises multiple feedback intervals; and

b) selection means, responsive to the measurement means, for selecting a preferred weight set during the measurement interval.

29. A communication system, capable of applying overlaid perturbation vectors for gradient feedback transmit antenna array adaptation, comprising:

a) a transmitter, capable of overlaying at least one weight vector perturbation vector, and determining a new weight vector perturbation vector based on feedback; and

b) a receiver, capable of measuring multiple weight vector perturbation vectors during a measurement interval, wherein the measurement interval has a greater duration than a feedback interval, and generating a feedback.

30. A transmitter, capable of:

a) applying overlaid perturbation vectors for gradient feedback transmit antenna array adaptation;

b) overlaying at least one weight vector perturbation vector;

c) transmitting a signal using the at least one weight vector perturbation vector;

d) determining a new weight vector perturbation vector based on feedback; and

e) receiving data from a receiver that is capable of measuring multiple weight vector perturbation vectors during a measurement interval, wherein the measurement interval has a greater duration than a feedback interval, and generating a feedback.

31. A receiver, capable of:

a) applying overlaid perturbation vectors for gradient feedback transmit antenna array adaptation;

b) measuring multiple weight vector perturbation vectors during a measurement interval, wherein the measurement interval has a greater duration than a feedback interval;

c) generating a feedback; and

d) receiving data from a transmitter that is capable of overlaying at least one weight vector perturbation vector, and determining a new weight vector perturbation vector based on the feedback generated by the receiver.